815 METAL FOR STRUCTURES

815.01 STRUCTURAL STEEL

The materials shall conform to the specifications as listed in the following tabulation with modifications and additions as specified herein.

(A) STRUCTURAL CARBON STEEL. AASHTO M 183.

(B) HIGH-STRENGTH LOW ALLOY STRUCTURAL STEEL. High-strength low-alloy structural steel, high-strength low-alloy structural steel for welding, and high- strength structural steel for bolted construction shall conform to:

(1) High-Strength Low-Alloy Structural Steel - AASHTO M 161.

(2) High-Strength Low-Alloy Structural Manganese Vanadium Steel - AASHTO M 188.

(3) High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality (Grades 42 and 50 for welding) - AASHTO M 223.

(4) High-Strength Low-Alloy Structural Steel with 50,000 psi Minimum Yield Point to 4-in. Thick - AASHTO M 222.

(C) HIGH-YIELD STRENGTH, QUENCHED, AND TEMPERED ALLOY STEEL PLATE.

(1) High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding - AASHTO M 244.

(2) Pressure Vessel Plates, Alloy Steel, High Strength, Quenched and Tempered.

(a) Structural shapes (Maximum tensile strength 140,000 psi) - AASHTO M 244.

(b) Seamless mechanical tubing (Maximum tensile strength 145,000 psi) - ASTM A 517.

(D) HIGH-STRENGTH FASTENERS

(1) Bolts - AASHTO M 164, Table 815A, and ANSI B18.2.1 and B1.1

(2) Nuts - AASHTO M 291, Table 815A, and ANSI B18.2.2 and B1.1

(3) Washers - AASHTO M 293 and Table 815B

(E) WELDING ELECTRODES. Welding electrodes, electrode testing, and certification shall conform to the requirements of the AASHTO Standard Specifications for Welding of Structural Steel Highway Bridges and the edition of AWS Structural Welding Code which AASHTO incorporates.

(F) WELDED STUDS. Welding of studs shall meet the requirements of AASHTO Standard Specifications for Welding of Structural Steel Highway Bridges and the edition of AWS Structural

Welding Code which AASHTO incorporates.

(G) PINS AND ROLLERS.

(1) Greater than 9 inches diameter - AASHTO M 102, Class E.

(2) Nine inches diameter or less - AASHTO M 102, Class E or AASHTO M 169, Grade 1022 to 1030 inclusive; with minimum Rockwell Scale B Hardness of 85 or minimum tensile strength of 72,000 psi and minimum yield point of 36,000 psi.

(H) ANCHOR BOLTS. ASTM A 307.

(I) CAST STEEL. AASHTO M 103, Grade 65-35, fully annealed.

(J) TOUGHNESS. All structural steel plate within the tension zone shall meet the longitudinal Charpy V-notch impact requirements determined and specified as follows for Zone 2:

Material (AASHTO)	Supplemental Requirement
M 161	S1
M 183	S3
M 188	S1
M 222	S1
M 223	S2
M 244	S3

(K) NUTS, BOLTS AND WASHERS. Nuts, bolts and washers for steel guiderail shall conform to AASHTO M 180.

(L) CARBON STEEL EXTERNALLY THREADED FASTENERS. ASTM A 307.

815.02 PRESTRESSING REINFORCEMENT

Prestressing reinforcement shall be high-tensile-strength steel wire, high-tensile-strength seven-wire strand, or high- tensile-strength alloy bars as specified in the contract documents.

All wire, strand, or bars to be shipped to the site shall be assigned a lot number and tagged for identification purposes. Anchorage assemblies to be shipped shall be likewise identified.

All samples submitted shall be representative of the lot to be furnished and, in the case of wire or strand, shall be taken from the same master roll.

All of the materials specified for testing shall be furnished free of cost and shall be delivered in time for tests to be made well in advance of anticipated time of use.

Where the Engineer intends to require nondestructive testing of one or more parts of the structure, special specifications shall be drawn giving the required details of the work.

The vendor shall furnish for testing the following samples selected from each lot including heat and

reel numbers for each sample. If ordered by the Engineer, the selection of samples shall be made at the manufacturer's plant by the inspector.

(A) SAMPLES.

(1) PRE-TENSIONING METHOD. For pre- tensioned strands, one sample at least 7 feet long shall be furnished in accordance with the requirements of paragraph 9.1 of AASHTO M 203.

(2) POST-TENSIONING METHOD. The following lengths shall be furnished:

(a) For wires requiring heading - 5 feet.

(b) For wires not requiring heading - sufficient length to make up one parallel-lay cable 5 feet long consisting of the same number of wires as the cable to be furnished.

(c) For strand to be furnished with fittings - 5 feet between near ends of fittings.

(d) For bars to be furnished with threaded ends and nuts - 5 feet between threads at ends.

(e) Anchorage assemblies - Two anchorage assemblies shall be furnished, complete with distribution plates of each size and type to be used, if anchorage assemblies are not attached to reinforcement samples.

(B) HIGH-TENSILE-STRENGTH STEEL. The high- tensile-strength steel shall be made by the basic-oxygen, open hearth, or electric-furnace process. The wire shall be cold drawn to size and suitably stress-relieved after cold drawing by a continuous strand heat treatment to produce the prescribed mechanical properties.

High-tensile-strength steel wire shall conform to the requirements of AASHTO M 204.

(C) HIGH-TENSILE-STRENGTH SEVEN WIRE STRAND. High-tensile-strength seven-wire strand shall conform to the requirements of AASHTO M 203, for the grade specified in the contract documents.

(D) HIGH-TENSILE-STRENGTH ALLOY BARS. High-tensile-strength alloy bars shall be stress relieved and then cold stretched to a minimum of 130,000 psi. After cold stretching, the physical properties shall be as follows:

Minimum ultimate tensile strength ....145,000 psi
Minimum yield strength, measured by the
0.7 percent extension under load method

shall not be less than ....130,000 psi
Minimum modulus of elasticity ... .25,000,000 psi
Minimum elongation in 20-bar diameters after
rupture..... ....4 percent
Diameter tolerance .. ..+0.03", -0.01"

815.03 STEEL CASTINGS

(A) STEEL CASTINGS FOR HIGHWAY BRIDGES. Steel castings for use in highway bridge components shall conform to AASHTO M 192, Class 70, or AASHTO M 103, Grade 70-36.

(B) CHROMIUM ALLOY-STEEL CASTINGS. Chromium alloy steel castings shall conform to AASHTO M 163, Grade CA-15.

815.04 GRAY IRON CASTINGS

Gray iron castings shall conform to the requirements of AASHTO M 105, Class 30 A.

Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow-holes and other defects in position affecting their strength and value for the service intended.

Castings shall be boldly filleted at the angles and the arrises shall be sharp and perfect.

All castings must be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean and uniform surface.

815.05 DUCTILE IRON CASTINGS

Ductile iron castings shall conform to the Specifications for Ductile Iron Castings, ASTM A 536, Grade 60-40-18, unless otherwise specified. In addition to the specified test coupons, test specimens from parts integral with the castings, such as risers, shall be tested for castings weighing more than 1000 pounds to determine that the required quality is obtained in the castings in the finished condition.

Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects in position affecting their strength and value for the service intended.

Castings shall be boldly filleted at angles and the arrises shall be sharp and perfect.

All castings must be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean, and uniform surface.

815.06 BRONZE CASTINGS

Bronze castings shall conform to AASHTO M 107. Alloy No. 913 or 911.

815.07 CARBON STEEL FORGINGS

Steel forgings shall conform to AASHTO M 102, Class C.

815.08 ALLOY STEEL FORGINGS

Alloy steel forgings shall conform to AASHTO M 102, Class A.

815.09 COLD FINISHED CARBON STEEL SHAFTING

Cold finished carbon steel shafting shall conform to AASHTO M 169, Grade Designation 1016 to 1030, inclusive.

815.10 COPPER-ALLOY PLATES

Copper-Alloy Plates shall conform to ASTM B 100.

815.11 LEAD

Lead shall conform to ASTM B 29.

815.12 SHEET ZINC

Sheet zinc shall conform to ASTM B 69, Type II.

815.13 COPPER FLASHING

All copper flashing shall be made of 16 oz. copper conforming to the requirements of ASTM B 370, soft. It shall be machine bent to shapes and widths shown on the plans.

815.14 TURNBUCKLES

Turnbuckles for steel beam guiderail shall conform to AASHTO M 269.

Tensile properties shall be determined in accordance with ASTM A 370. Tensile tests of finished anchors and stud shall be made on units welded to test plates. If fracture occurs outside the middle half of the gage length, the test shall be repeated.

TABLE 815 A
BOLT AND NUT DIMENSIONSa

Nominal Bolt Sizes D	Heavy Hexagon Structural Bolts			Heavy Semi-Finished Hexagon Nuts	
	Width Across	Thread Width Across			
	Flats F	Height H	Length T	Flats W	Height H
1/2	7/8	5/16	1	7/8	31/64
5/8	1-1/16	25/64	1-1/4	1-1/16	39/64
3/4	1-1/4	15/32	1-3/8	1-1/4	47/64
7/8	1-7/16	35/64	1-1/2	1-7/16	55/64
1	1-5/8	39/64	1-3/4	1-5/8	63/64
1-1/8	1-13/16	11/16	2	1-13/16	1-7/64
1-1/4	2	25/32	2	2	1-7/32
1-3/8	1-3/16	27/32	2-1/4	2-3/16	1-11/32
1-1/2	2-3/8	15/16	1-1/4	2-3/8	1-15/32